# Supplemental Environmental Impact Statement/
# Overseas Environmental Impact Statement
# Mariana Islands Training and Testing

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## 3.8 Marine Invertebrates

### 3.8.1 Affected Environment

The purpose of this section is to supplement the analysis of impacts on marine invertebrates presented in the 2015 Mariana Islands Training and Testing (MITT) Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) with new information relevant to proposed changes in training and testing activities conducted at sea and on Farallon De Medinilla (FDM). New information made available since the publication of the 2015 MITT Final EIS/OEIS is included below to better understand potential stressors and impacts on marine invertebrates resulting from training and testing activities. Comments received from the public during scoping related to marine invertebrates are addressed in Section 3.8.3 (Public Comments). Comments received from the public during the Draft Supplemental EIS (SEIS)/OEIS commenting period related to marine invertebrates are addressed in Appendix K (Public Comment Responses).

Sensitive habitats in the Study Area include deep sea hydrothermal vents and coral reefs. As discussed in Section 3.3 (Marine Habitats), hydrothermal vents in the Study Area are located in the Mariana Archipelago (U.S. Fish and Wildlife Service, 2012). These areas support marine biological communities that are dependent on basalt rock foundations, unlike those throughout the remainder of the Pacific. Hydrothermal vent communities are typically low in species composition, but high in abundance of those few species. Deep-water benthic communities, including hydrothermal vents, include animals that have developed symbiotic relationships with chemosynthetic bacteria, such as tubeworms, shrimp, and mussels, as well as other animals like snails, anemones, and squat lobsters (Glickson et al., 2017) and take extremely long to recover from disturbances (Simon-Lledo et al., 2019).

Coral reefs in the Study Area are threatened by unsustainable fishing practices, climate change, land-based sources of pollution, overuse, and lack of enforcement (National Oceanic and Atmospheric Administration, 2018a). Coral reefs within the Mariana Islands are moderately impacted, and their overall condition is considered fair. Coral reefs in the northern islands are in good condition, while the southern islands such as Saipan had the most diverse types of coral reefs and associated habitats in the Mariana Islands (National Oceanic and Atmospheric Administration, 2018a). In contrast, coral reef condition in Tinian and Rota are considered impacted. While these conditions reflect data collected through summer 2017, very recent data suggest coral reef bleaching has resulted in severe impacts, with up to 90 percent loss for some branching coral species occurring around Saipan and Tinian (National Oceanic and Atmospheric Administration, 2018a). It is unclear what the impact of these bleaching events will be on all reefs of the Mariana Islands, but preliminary information suggests widespread loss across the archipelago.

Smith and Marx (2016) presented results from dive surveys in waters surrounding the live-fire range off FDM that provide qualitative observations of water and sediment quality and noted the condition of the biological resources (see Section 3.1, Sediments and Water Quality). A moderate bleaching event was noted in 2007, and a barnacle infestation was noted in 2012 (Smith et al., 2013). The bleaching event was regional and extended from southern Japan through the Mariana Islands and south through waters surrounding Palau. Subsequent surveys observed soft and fire corals had recovered completely; 75 percent of the stony corals had recovered by 2008 and the coral fauna at FDM were observed to be healthy and robust (Smith & Marx, 2009, 2016). The nearshore physical environment and basic habitat types at FDM have remained unchanged over the 13 years of survey activity. These conclusions are based on (1) a limited amount of physical damage, (2) very low levels of partial mortality and disease (less than 1 percent of all species observed), (3) absence of excessive mucus production, (4) good coral recruitment, (5) complete recovery by 2012 of the 2007 bleaching event, and (6) a limited number of macrobioeroders and an absence of invasive crown of thorns starfish (*Acanthaster planci*).

A recent coral reef survey by Carilli et al. (2018) at FDM verified Endangered Species Act (ESA)-listed corals, quantified coral reef health, and compiled observations of ordnance impacts. Percent coral cover from these surveys is presented in Figure 3.8-1.

The survey results indicated that ESA-listed corals are present, but rare in waters of <20 meters (m) depth around FDM. Additionally, 77.3 percent of corals observed exhibited some form of bleaching, likely caused by regionally anomalous warm sea surface temperatures. Carilli et al. (2018) found little evidence of adverse impacts on coral from Navy training and testing, including the use of high-explosive bombs, and scleractinian coral growth occurred on a substantial percentage of ordnance items expended.

Guam's coral reefs are moderately impacted, and overall conditions are fair (National Oceanic and Atmospheric Administration, 2018b). Guam's reefs are struggling against threats such as pollution, overfishing, and climate change. Coral cover on Guam is generally similar to other southern Mariana Islands, but lower than the northern islands (Raymundo et al., 2016). Because coral distribution and coral cover on reefs is naturally patchy and heterogeneous, a single island-wide number is not a representative summary of the coral community. Long-term monitoring surveys conducted by the National Marine Fisheries Service's Pacific Assessment and Monitoring Program found approximately 10–15 percent coral cover overall, but the recent multi-year coral bleaching events have had variable consequences for the reef communities on Guam. For example, Raymundo et al. (2017) estimated a 53 percent decline in staghorn *Acropora* spp. on Guam. Of the 21 sites in the study, 6 are on Joint Region Marianas-administered submerged lands including 4 in Apra Harbor. The estimated mean mortality of staghorn *Acropora* spp. was 80 percent at Big Blue Shoals, 80 percent at Western Shoals, 30 percent at Dogleg, and 90 percent at Gab Gab (Raymundo et al., 2016). In the past several years, corals in Guam have been bleaching regularly each summer and recovery has been limited, leading to significant levels of coral mortality (Harvey, 2016; Raymundo et al., 2017).

Even though the new studies show variability in coral cover at FDM, including decreases in cover of some coral species off Guam, this information does not appreciably change the analysis presented in the 2015 MITT Final EIS/OEIS.

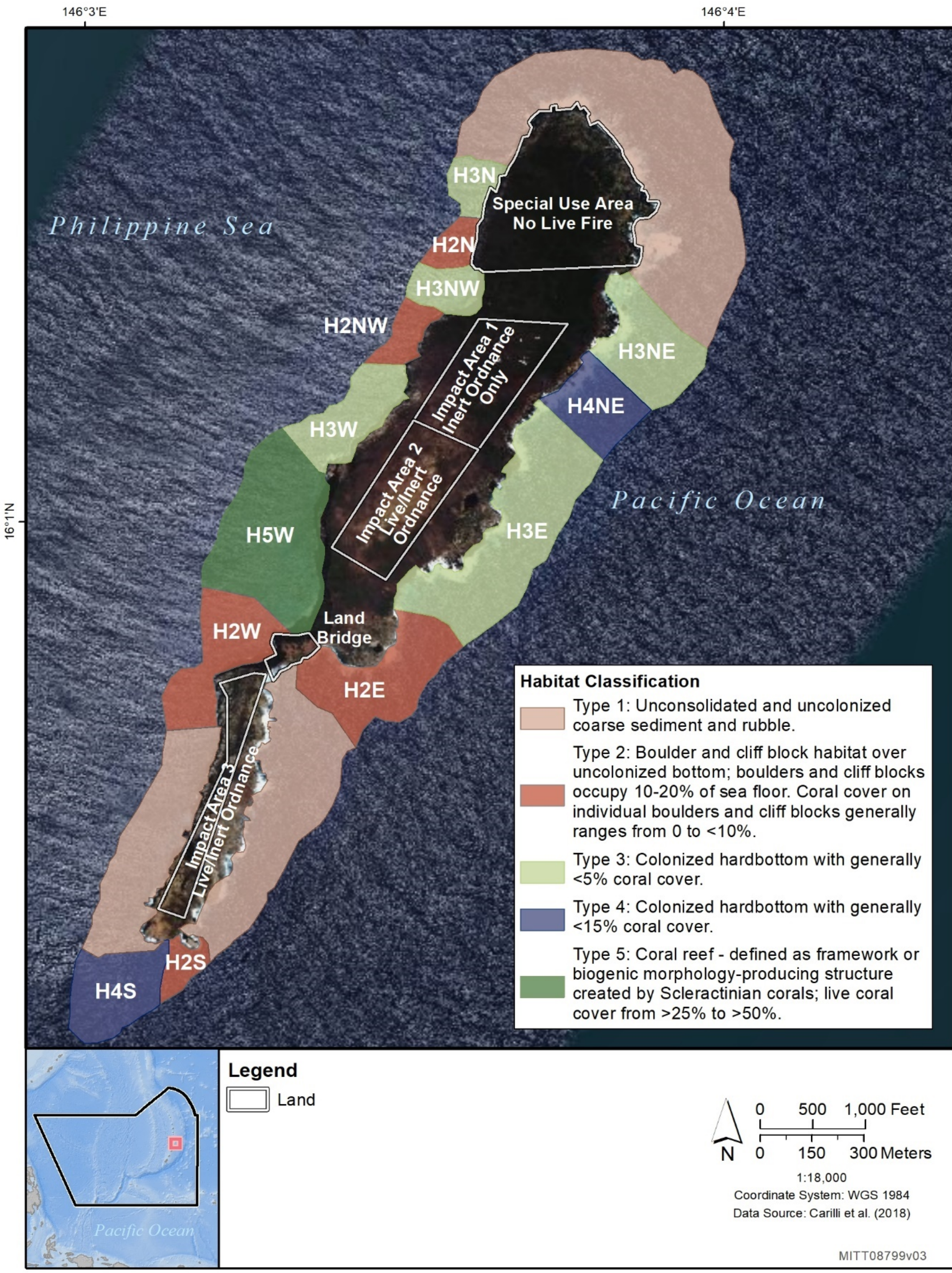


**Figure 3.8-1: Percent Coral Cover and Habitat Types Around Farallon de Medinilla**

#### 3.8.1.1 Sound Sensing and Production

New studies on particle motion detection by Roberts et al. (2016) reinforces the finding that mechanical receptors on some invertebrates are found on various body parts. In addition, these structures are connected to the central nervous system and can detect some movements or vibrations that are transmitted through substrate (Edmonds et al., 2016). However, the addition of this new information does not appreciably change the information or analysis presented in the 2015 MITT Final EIS/OEIS.

#### 3.8.1.2 General Threats

The health and abundance of marine invertebrates and general threats to coral reef systems are well documented and discussed in detail in the 2015 MITT Final EIS/OEIS. These threats include stress or damage by coastal development (Risk, 2009), impacts from inland pollution and erosion (Cortes and Risk 1985), overexploitation and destructive fishing practices (Jackson et al., 2001; Pandolfi et al., 2003), disease (Porter et al., 2001), predation, harvesting by the aquarium trade (Caribbean Fishery Management Council, 1994, 2016), anchors (Burke & Maidens, 2004), invasive species (Bryant et al., 1998; Galloway et al., 2009; National Marine Fisheries Service, 2010; Wilkinson, 2002), ship groundings (National Oceanic and Atmospheric Administration, 2010), oil spills (National Oceanic and Atmospheric Administration, 2010), marine debris (Lusher et al., 2016), disturbance by recreational activities at beaches, possibly human-made noise (Brainard et al., 2011; Vermeij et al., 2010), and global climate change, which includes impacts such as increases in sea surface temperature (van Hooidonk et al., 2016) and ocean acidification (Anthony, 2016; Hughes et al., 2003). Several studies suggest a direct link between declining water quality from increased runoff and sedimentation and coral reef health and bleaching (Ennis et al., 2016; Gailani et al., 2016; Nelson et al., 2016). Coral bleaching and bleaching of other invertebrates such as anemones, which occurs when symbiotic algae living in their tissues is expelled, is a stress response often tied to atypically high sea temperatures or changes in light availability but also can be attributed to nutrients, toxicants, and pathogens (National Oceanic and Atmospheric Administration, 2017). For example, toxicants such as oxybenzone and zinc and titanium oxide found in sunscreens and personal beauty products have been shown to induce severe and rapid coral bleaching due to the alteration of the symbiosis between coral and zooxanthellae (Corinaldesi et al., 2018; Downs et al., 2016).

#### 3.8.1.3 Endangered Species Act-Listed Species

In 2014, the National Marine Fisheries Service (NMFS) published the Final Rule (79 Federal Register 53851) protecting 22 coral species under the Endangered Species Act (ESA), including the two corals (elkhorn and staghorn) listed as threatened in 2006. NMFS also determined that the remainder of the proposed species do not warrant listing as endangered or threatened species, and three proposed species (proposed October 2013) were not determinable under the ESA. Only three coral species (*Acropora globicep*s, *A. retusa*, and *Seriatopora aculeata*) are listed under the ESA and occur in the Study Area (Table 3.8-1). New information that supplements existing knowledge on disturbance responses and survivorship of some ESA-listed corals in the genus *Acropora* is detailed in Drury et al. (2017), and reactions of some coral species to thermal stress during a coral restoration project in the Caribbean is documented in (Ladd et al., 2017)). Since the species were listed, there are only a few locations where a federal ESA-listed coral species has been positively identified in the Study Area. Carilli et al. (2018) found ESA-listed corals are present, but rare in waters of <20 m depth around FDM. In April 2015, several colonies of ESA-listed *Acropora globiceps* were encountered during a 40-minute non-systematic survey at Spanish Steps in Outer Apra Harbor (Lybolt, 2015). The colonies were seen in very shallow water less than 3.3 feet (ft.) (1 m) deep. Spanish Steps is just inside the tip of the Orote Peninsula, which is a dynamic location that is exposed to some effect from the ocean outside the harbor. The area has high coral coverage of commonly seen species from Apra Harbor. A second colony was recorded from the reef crest south of Dadi Beach in September 2016. The single colony was approximately 10–15 inches (25–30 centimeters) across and was observed during a non-systematic survey of the nearshore area at Dadi Beach (Moribe et al., 2016). Even though these observations represent new information on ESA-listed corals, it does not alter the analysis from the 2015 MITT Final EIS/OEIS. Therefore, all other information presented in the 2015 MITT Final EIS/OEIS on corals that occur in the Study Area remains valid.

In 2017, NMFS determined that seven species of giant clam (*Hippopus, H. porcellanus, Tridacna costata, T. derasa, T. gigas, T. squamosa*, and *T. tevoroa*) were candidates that may warrant listing under the ESA (82 Federal Register 28946). A status review is currently being done for these species. Two species, *H. hippopus* and *T. gigas*, have historically been found in the Study Area, but are believed to have been locally extirpated (Meadows, 2016).

**Table 3.8-1: Status of Endangered Species Act-Listed Species Within the Study Area**

| Species Name and Regulatory Status | | | Presence in Study Area | |
|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Endangered Species Act Status** | **Open Ocean/ Transit Corridor** | **Coastal Ocean** |
| Staghorn/Stony coral | *Acropora globiceps* | Threatened | No | Yes |
| Staghorn/Stony coral | *Acropora retusa* | Threatened | No | Yes |
| Club finger coral | *Seriatopora aculeata* | Threatened | No | Yes |
| Giant clam | *Hippopus* | Candidate | No | * |
| Giant clam | *Tridacna gigas* | Candidate | No | * |

* May be locally extirpated

#### 3.8.1.4 Taxonomic Groups

The information presented on invertebrate taxonomic groups in the Study Area, as listed in the 2015 MITT Final EIS/OEIS, has not changed and remains valid.

### 3.8.2 Environmental Consequences

The 2015 MITT Final EIS/OEIS considered training and testing activities proposed to occur in the Study Area that may have the potential to impact marine invertebrates. The stressors applicable to marine invertebrates in the Study Area are the same stressors in the 2015 MITT Final EIS/OEIS and are listed below:

- Acoustic (sonar and other transducers, vessel noise, aircraft noise, weapons noise)
- Explosive (in-air explosions and in-water explosions)
- Energy (in-water electromagnetic devices and high-energy lasers)
- Physical disturbance and strike (vessels and in-water devices, military expended materials, seafloor devices, and personnel disturbance)
- Entanglement (wires and cables, decelerators/parachutes)
- Ingestion (military expended materials – munitions and military expended materials – other than munitions)
- Secondary stressors (impacts on habitat and impacts on prey availability)

This section evaluates how and to what degree potential impacts on marine invertebrates from stressors described in Section 3.0 (General Approach to Analysis) may have changed since the analysis presented in the 2015 MITT Final EIS/OEIS was completed. Tables 2.5-1 and 2.5-2 in Chapter 2 (Description of Proposed Action and Alternatives) list the proposed training and testing activities and include the number of times each activity would be conducted annually and the locations within the Study Area where the activity would typically occur under each alternative. The tables also present the same information for activities described in the 2015 MITT Final EIS/OEIS so that the proposed levels of training and testing under this SEIS/OEIS can be easily compared.

The Navy conducted a review of federal and state regulations and standards relevant to marine invertebrates and reviewed scientific literature published since 2015 for new information on marine invertebrates that could inform the analysis presented in the 2015 MITT Final EIS/OEIS. Since 2006, the Navy, non-Navy scientists, research groups, and universities have conducted scientific monitoring and research in and around ocean areas in the Pacific where the Navy has been and proposes to continue training and testing. The analysis provided in this SEIS/OEIS will be the third time Navy training and testing activities at sea have been comprehensively analyzed in the Study Area. Data collected from the Navy has increased the knowledge of corals in the Study Area. For example, Smith and Marx (2016) conducted a coral reef dive survey on Farallon de Medinilla that used new methods of georeferencing the locations of sighted coral, and documented the existence of a few specimens of two ESA-listed species (*Acropora globiceps* and *Pavona diffluens*), including one species (*Pavona diffluens*) that had not previously been positively identified in the Mariana archipelago. Carilli et al. (2018) found six colonies of possible *Pavona diffluens* (four off the west shoreline, and two off the east shoreline on the northern portion of FDM). The NMFS Final Rule that included the listing of *Pavona diffluens* (79 FR 53851) only included Red Sea/Indian Ocean populations because of taxonomic uncertainty that Pacific populations may be a different species. Because the listing of *Pavona diffluens* only covers colonies outside of the Study Area, this species is not included in the specific analysis of ESA-listed species. Habitat maps were also developed from previous surveys and were refined, confirming that only a small subportion of the nearshore waters were characterized as high-quality coral reef. The analysis presented in this section also considers standard operating procedures, which are discussed in Section 2.3.3 (Standard Operating Procedures) of this Final SEIS/OEIS, and mitigation measures that are described in Chapter 5 (Mitigation). The Navy would implement these measures to avoid or reduce impacts on seafloor resources (including shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks) from explosives during applicable activities, as described in Section 5.4.1 (Mitigation Areas for Seafloor Resources).

#### 3.8.2.1 Acoustic Stressors

Little information is available on the potential impacts on marine invertebrates from exposure to sonar and other sound-producing activities. Most studies have focused on a few species (squid or crustaceans) and the consequences of exposures to broadband impulsive air guns typically used for seismic exploration, rather than on sonar or explosions. While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.1 (Acoustic Stressors), remains applicable. The changes in training and testing activities are not substantial and would not result in an overall change to existing environmental conditions or an increase in the level or intensity of acoustic stressors within the Study Area.

As stated in the 2015 analysis, marine invertebrates are generally not sensitive to most sounds that would result from the proposed activities. New information presented on particle motion detection by

Roberts et al. (2016) found mechanical receptors on some invertebrates may be connected to the central nervous system and can detect some movements or vibrations that are transmitted through substrate. Even though some invertebrates may be able to sense or detect particle motion, they would not be impacted by acoustic sources used during training and testing activities, and a recent literature review on assessing impacts of underwater noise on marine fishes and invertebrates (Hawkins & Popper 2017) does not change this conclusion. Therefore, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.1 (Acoustic Stressors), remains valid and applicable.

#### 3.8.2.1.1 Impacts from Acoustic Stressors Under Alternative 1

Under Alternative 1, there would be an overall decrease in the number of sonar hours used in the Study Area during training and testing activities compared to the number analyzed in the 2015 MITT Final EIS/OEIS (Table 3.0-2 and Figure 2.4-1). Therefore, the analysis in the 2015 MITT Final EIS/OEIS remains valid. Decreases in the number of training and testing events would potentially decrease the level of acoustic stressors in the Study Area. Decreases in sonar hours shown in Table 3.0-2 for activities proposed under Alternative 1 would have no appreciable change on the impact analysis or conclusions for acoustic stressors presented in the 2015 MITT Final EIS/OEIS.

As described in the 2015 MITT Final EIS/OEIS, marine invertebrates throughout the Study Area may be exposed to non-impulsive sounds generated by low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft noise during training and testing activities. Acoustic impacts on marine invertebrates under Alternative 1 would be inconsequential because most marine invertebrates would not be close enough to intense sound sources. Any marine invertebrate capable of sensing sound may alter its behavior and become disoriented due to masking of relevant environmental sounds if exposed to non-impulsive sound, although it is unknown if responses to non-impulsive sounds occur. Continuous noise, such as from vessels, may also contribute to masking of relevant environmental sounds. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would last only minutes. Furthermore, invertebrate species have their best sensitivity to sound below 1 kilohertz and would not be capable of detecting the majority of sonars and other acoustic sources used in the Study Area. Therefore, non-impulsive sounds associated with Alternative 1 are not expected to impact the majority of marine invertebrates or cause more than a short-term behavioral disturbance (e.g., change in orientation or swim speeds) to those marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

*Pursuant to the ESA, the use of sonar and other transducers associated with training and testing activities, as described under Alternative 1, would have no effect on ESA-listed coral species.*

#### 3.8.2.1.2 Impacts from Acoustic Stressors Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the number of sonar hours used during training and testing activities would decrease compared to the numbers analyzed in the 2015 MITT Final EIS/OEIS and increase compared to Alternative 1 of this SEIS/OEIS (Table 3.0-2 and Figure 2.4-1). Under Alternative 2, increases in the number of sonar hours would have no appreciable change on the impact conclusions for acoustic stressors as summarized above under Alternative 1 and as presented in the 2015 MITT Final EIS/OEIS. Therefore, acoustic impacts on marine invertebrates under Alternative 2 would be negligible.

*Pursuant to the ESA, the use of sonar and other transducers associated with training and testing activities, as described under Alternative 2, would have no effect on ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.1.3 Impacts from Acoustic Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Acoustic stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer acoustic stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for acoustic impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.2 Explosive Stressors

Explosives introduce loud, impulse, broadband sounds into the marine environment. Impulse sources are characterized by rapid pressure rise times and high peak pressures. Explosions produce high-pressure shock waves that could cause injury or physical disturbance due to rapid pressure changes. Impulse sounds are usually brief, but the associated rapid pressure changes can injure or startle marine invertebrates. While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.1 (Acoustic Stressors), remains applicable. The changes in training and testing activities are not substantial and would not result in an overall change to existing environmental conditions or an increase in the level or intensity of explosive stressors within the Study Area.

As stated above, in the 2015 analysis, and results reported in Roberts et al. (2016) and Edmonds et al. (2016), marine invertebrates are generally not sensitive to most sounds that would result from the proposed activities, but likely have mechanical receptors that may be connected to the central nervous system that can detect some movements or vibrations that are transmitted through substrate. Given that the activities would also be conducted at similar levels as described in the 2015 analysis, there would be no change to the conclusions. Therefore, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.1 (Acoustic Stressors), remains valid.

Although the vast majority of explosions occur at distances greater than 3 nautical miles from shore (where water depths are greater than the depths where shallow-water coral species occur), some explosions may occur close to marine invertebrates that would kill or injure those invertebrates. Explosions near the seafloor and very large explosions in the water column may impact shallow-water corals of any life stage, hard-bottom habitat and associated marine invertebrates, and deep-water corals. Effects could include physical disturbance, fragmentation, or mortality to sessile organisms and pelagic larvae. Energy from an explosion at the surface would dissipate below detectable levels before reaching the seafloor and would not injure or otherwise impact deep-water, benthic marine invertebrates.

#### 3.8.2.2.1 Impacts from Explosive Stressors Under Alternative 1

Under Alternative 1, there would be an overall decrease in the number of explosive ordnance used in the Study Area during training and testing activities compared to the number analyzed in the 2015 MITT Final EIS/OEIS (Table 3.0-7 and Figure 2.4-2). Under Alternative 1, underwater detonations would increase for underwater demolition qualification/certification (Table 2.5-1). However, these activities would continue to occur in the same areas at the Agat Bay site, Piti, and Outer Apra Harbor sites, and would have no appreciable change in the impact analysis or conclusions for explosive stressors as presented in the 2015 MITT Final EIS/OEIS. Decreases in activities proposed under Alternative 1 would have no appreciable change on the impact analysis or conclusions for explosive stressors presented in the 2015 MITT Final EIS/OEIS.

Explosions in the water or near the water surface would injure invertebrates at the surface but would not injure benthic marine invertebrates, including those living in hydrothermal vents, because of the great water depth in areas where most explosive will be used. As described above, explosions at or near the surface would likely kill or injure nearby pelagic marine invertebrates. Effects could include physical disturbance, fragmentation, or mortality.

As described above, the vast majority of explosive detonations during training and testing activities would occur in waters greater than 3 nautical miles from shore, which are not known to support ESA-listed coral species. In addition, energy from an explosion at the surface would dissipate below detectable levels before reaching the seafloor and would not injure or otherwise impact deep-water, benthic marine invertebrates. However, various developmental stages such as eggs, sperm, early embryonic stages, and planula larvae of corals, as well as adults, could be impacted in areas overlapping with other training and testing activities using explosives. Consequences of exposure to an explosive shock wave could include breakage, injury, or mortality. Many corals and hard-bottom invertebrates are sessile, fragile, and particularly vulnerable. Because exposures to explosive shock waves are brief, limited in number, and spread over a large area, no long-term impacts are expected. Explosives may impact individual marine invertebrates and groups of marine invertebrates, but they are unlikely to impact populations or subpopulations. Therefore, impacts of explosives on marine invertebrates under Alternative 1 would be negligible.

As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid or reduce impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks. The mitigation will consequently also help avoid or reduce potential impacts on invertebrates that inhabit these areas. There is also procedural mitigation that affects "jellyfish aggregations," specifically for explosive torpedoes and sinking exercises (see Section 5.3.3, Explosive Stressors). Additionally, the Navy will require Lookouts to observe the water's surface before and during sinking exercises and the use of explosive torpedoes to avoid or reduce jellyfish aggregations.

*Pursuant to the ESA, the use of explosives associated with training and testing activities, as described under Alternative 1, may affect ESA-listed coral species.*

#### 3.8.2.2.2 Impacts from Explosive Stressors Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the number of explosives used during training and testing activities would decrease compared to the numbers analyzed in the 2015 MITT Final EIS/OEIS and increase compared to Alternative 1 (Table 3.0-7 and Figure 2.4-2). Under Alternative 2, increases in the number of underwater explosives would have no appreciable change on the impact conclusions for explosive stressors as summarized above under Alternative 1 and as presented in the 2015 MITT Final EIS/OEIS.

Therefore, impacts on marine invertebrates under Alternative 2 from explosives would be negligible.

*Pursuant to the ESA, the use of explosives associated with training and testing activities, as described under Alternative 2, may affect ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.2.3 Impacts from Explosive Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Explosive stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer explosive stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for explosive impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.3 Energy Stressors

The energy stressors that may impact marine invertebrates include in-water electromagnetic devices and high energy lasers. The in-water electromagnetic devices stressor remains the same as analyzed in the 2015 MITT Final EIS/OEIS; high-energy lasers is a new stressor analyzed in this SEIS/OEIS. While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS for in-water electromagnetic devices remains valid and an analysis of potential impacts from high-energy laser use is presented below.

As discussed in Section 3.0.5.3.1.2 (High-Energy Lasers), high-energy lasers are designed to disable surface targets, rendering them immobile. The primary concern is the potential for an invertebrate to be struck with the laser beam at or near the water's surface, where extended exposure could result in injury or death.

Little information exists about marine invertebrates' susceptibility to electromagnetic fields. Most corals are thought to use water temperature, day length, lunar cycles, and tidal fluctuations as cues for spawning. Magnetic fields are not known to influence coral spawning or larval settlement. However, existing information suggests sensitivity to electric and magnetic fields in at least three marine invertebrate phyla: Mollusca, Arthropoda, and Echinodermata (Lohmann et al., 1995; Lohmann & Lohmann, 2006; Normandeau et al., 2011).

High-energy lasers were not proposed for use in the 2015 MITT Final EIS/OEIS. As discussed in Section 3.0.4.3.2.2 (High-Energy Lasers), high-energy laser weapons testing involves the use of directed energy as a weapon against small surface vessels and airborne targets. These weapons systems are deployed from a surface ship to create small but critical failures in potential targets and used at short ranges from the target.

Marine invertebrates could be exposed to a laser only if the beam missed the target. Should the laser strike the sea surface, individual invertebrates at or near the surface, such as jellyfish, floating eggs, and larvae could potentially be exposed. The potential for exposure to a high-energy laser beam decreases rapidly as water depth increases and varies with time of day, as many zooplankton species migrate away from the surface during the day. Most marine invertebrates, including those that live in hydrothermal vents, are not susceptible to laser exposure because they occur beneath the sea surface.

#### 3.8.2.3.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

Under Alternative 1, the number of proposed training and testing activities involving the use of in-water electromagnetic devices would decrease in comparison to the 2015 MITT Final EIS/OEIS (Table 3.0-9). The activities would occur in the same locations and in a similar manner as were analyzed previously.

Therefore, impacts on marine invertebrates under Alternative 1 from in-water electromagnetic devices would be negligible.

*Pursuant to the ESA, the use of in-water electromagnetic devices associated with training and testing activities, as described under Alternative 1, would have no effect on ESA-listed coral species.*

#### 3.8.2.3.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the number of proposed training and testing activities involving the use of in-water electromagnetic devices would decrease in comparison to the 2015 MITT Final EIS/OEIS (Table 3.0-9). The activities would occur in the same locations and in a similar manner as were analyzed previously and above for Alternative 1.

Therefore, impacts on marine invertebrates under Alternative 2 from in-water electromagnetic devices would be negligible.

*Pursuant to the ESA, the use of in-water electromagnetic devices associated with training and testing activities, as described under Alternative 2, would have no effect on ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.3.3 Impacts from In-Water Electromagnetic Devices Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Energy stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer in-water electromagnetic stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for energy impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

#### 3.8.2.3.4 Impacts from High-Energy Lasers Under Alternative 1

No high-energy lasers are proposed for training activities under Alternative 1. Under Alternative 1, the number of proposed testing events involving the use of high-energy lasers would be 54 (Table 3.0-10); this is a new substressor that was not analyzed in the 2015 MITT Final EIS/OEIS.

The primary concern for high-energy weapons testing is the potential for a marine invertebrate to be struck by a high-energy laser beam at or near the water's surface, which could result in injury or death, resulting from traumatic burns from the beam. Invertebrates that do not occur at or near the sea surface would not be exposed due to the attenuation of laser energy with depth. Surface invertebrates such as squid, jellyfish, and zooplankton (which may include invertebrate larvae) exposed to high-energy lasers could be injured or killed, but the probability is low based on the relatively low number of events, very localized potential impact area of the laser beam, and the temporary duration of potential impact (seconds). Activities involving high-energy lasers are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level because of the relatively small number of individuals that could be impacted. The impact of high-energy lasers on marine invertebrates, including those that live in hydrothermal vents, would be inconsequential because (1) it is highly unlikely that a high-energy laser would miss its target, (2) it is highly unlikely that the laser would miss in such a way that the laser beam would strike a marine invertebrate, and (3) it is highly unlikely that the marine invertebrate would be at or near the surface, just as two equally unlikely events take place.

*Pursuant to the ESA, the use of high-energy lasers associated with testing activities, as described under Alternative 1, would have no effect on ESA-listed coral species.*

#### 3.8.2.3.5 Impacts from High-Energy Lasers Under Alternative 2 (Preferred Alternative)

As shown in Table 3.0-10, 60 testing events involving the use of high-energy lasers are proposed under Alternative 2, which is a slight increase from the number proposed under Alternative 1. Therefore, the impacts would be the same as described under Alternative 1.

*Pursuant to the ESA, the use of high-energy lasers associated with testing activities, as described under Alternative 2, would have no effect on ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.3.6 Impacts from High-Energy Lasers Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Energy stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer high-energy laser stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for energy impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.4 Physical Disturbance and Strike Stressors

The physical disturbance and strike stressors that may impact marine invertebrates include (1) vessels and in-water devices, (2) military expended materials, (3) seafloor devices, and (4) personnel disturbance. While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.3 (Physical Disturbance and Strike Stressors) remains valid. The changes in training and testing activities are not substantial and would not result in an overall change to existing environmental conditions or an increase in the level or intensity of physical disturbance and strike stressors within the Study Area.

Most marine invertebrate populations, including those that live in hydrothermal vents, extend across wide areas containing hundreds or thousands of discrete patches of suitable habitat. Sessile (attached to the seafloor or other surface) invertebrate populations may be maintained by complex currents that carry adults and young from place to place. Such widespread populations are difficult to evaluate in terms of Navy training and testing activities that occur intermittently and in relatively small patches in the Study Area. Even invertebrate populations that are somewhat restricted in range, such as coral reefs, cover enormous areas (see Section 3.3, Marine Habitats, for quantitative assessments). In this context, a physical strike or disturbance would impact individual organisms directly or indirectly.

As stated in the 2015 MITT Final EIS/OEIS, activities involving vessels and in-water devices are not intended to contact the seafloor. This would include amphibious and expeditionary events such as Amphibious Assaults, Amphibious Raids, Personnel Insertion/Extraction, and Underwater Surveys, which are proposed to continue in this SEIS/OEIS. These activities could occur at beaches at Babui, Chulu, and Dankulo on Tinian and could also occur at Dry Dock Island in Apra Harbor at Dadi Beach on Guam. During these activities, combat swimmers and other military personnel may be required to walk through nearshore areas. For example, as the boat approaches a beach, military personnel may be required to exit the boat, stand up, and walk through the shallow water habitats, which could disturb or injure some marine invertebrates. Benthic invertebrates of the reef crest or flat, such as crabs, clams, and polychaete worms, within the disturbed area could be displaced, injured, or killed during amphibious operations. As is current practice, coral and other hard bottom habitats would continue to be avoided to the greatest extent practical under the Proposed Action (see Section 2.3.3, Standard Operating Procedures and Chapter 5, Mitigation). However, combat swimmers and Marines may be required to walk through nearshore areas during these activities. For example, as the boat approaches a beach, Marines may be required to exit the boat, stand up, and walk through the shallow water habitats.

As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid or reduce impacts from precision anchoring and military expended materials on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks (except at designated nearshore training areas, where these resources will be avoided to the maximum extent practicable). The mitigation will consequently also help avoid or reduce potential impacts on invertebrates that inhabit these areas.

#### 3.8.2.4.1 Impacts from Physical Disturbance and Strike Stressors Under Alternative 1

Under Alternative 1, the combined number of proposed training and testing activities involving vessels and in-water devices (Table 3.0-12 and Table 3.0-13) would decrease slightly from those presented in the 2015 MITT Final EIS/OEIS. Military expended materials and munitions (Tables 3.0-14 through 3.0-17) combined would increase, and seafloor devices (Table 3.0-19) would decrease slightly from the number in the 2015 MITT Final EIS/OEIS, as well as the overall reduction of the footprint of expended materials. Increases in some physical disturbance and strike stressors, such as military expended materials, could increase the level of impact on some marine invertebrates, including those that live in hydrothermal vents. However, these changes do not appreciably change the analysis or impact conclusions presented in the 2015 MITT Final EIS/OEIS because the impact analysis was based on the probability of an impact on a resource.

As stated in the 2015 MITT Final EIS/OEIS, the impact of physical disturbance and strike stressors on marine invertebrates is likely to cause injury or mortality to individuals, such as corals on nearshore reefs, but impacts on populations, including those that live in hydrothermal vents, would be negligible because (1) the area exposed to the stressor is extremely small (localized) relative to most marine invertebrates' ranges, and (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event. Activities involving vessel and in-water devices, military expended material, seafloor devices, and personnel disturbance are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level. However, the combined consequences of all physical disturbance and strike stressors could degrade habitat quality at some locations. As stated above, combat swimmers and Marines may be required to walk through nearshore areas and reefs during these activities, potentially causing damage to coral species. As stated in the 2015 MITT Final EIS/OEIS and above, these activities could cause injury or mortality to individuals, but impacts on marine invertebrate populations, including ESA-listed corals, are unlikely.

Therefore, under Alternative 1, impacts on marine invertebrates from the use of vessels and in-water devices, military expended materials, and seafloor devices would be negligible.

*Pursuant to the ESA, the use of vessels and in-water devices, military expended materials, and seafloor devices during training and testing activities, as described under Alternative 1, may affect ESA-listed coral species.*

#### 3.8.2.4.2 Impacts from Physical Disturbance and Strike Stressors Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the combined number of proposed training and testing activities involving vessels and in-water devices would decrease slightly from those presented in the 2015 MITT Final EIS/OEIS (Table 3.0-12 and Table 3.0-13). Military expended materials (Tables 3.0-14 through 3.0-17) combined would increase, and seafloor devices (Table 3.0-19) would decrease slightly from the numbers in the 2015 MITT Final EIS/OEIS. Increases in some physical disturbance and strike stressors such as military expended materials could increase the impact risk on marine invertebrates, but do not appreciably change the analysis or impact conclusions presented in the 2015 MITT Final EIS/OEIS. Impacts on marine invertebrates would be inconsequential for the same reasons detailed above and there would be no appreciable change in the impact conclusions for physical disturbance and strike stressors, as presented in the 2015 MITT Final EIS/OEIS and summarized above under Alternative 1.

Therefore, under Alternative 2, impacts on marine invertebrates from the use of vessels and in-water devices, military expended materials, and seafloor devices would be negligible.

*Pursuant to the ESA, the use of vessels and in-water devices, military expended materials, and seafloor devices during training and testing activities, as described under Alternative 2, may affect ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.4.3 Impacts from Physical Disturbance and Strike Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Physical disturbance and strike stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer physical disturbance and strike stressors within the marine environment where Navy activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for physical disturbance and strike impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.5 Entanglement Stressors

Entanglement stressors that may impact marine invertebrates include (1) fiber optic cables and guidance wires, and (2) decelerators/parachutes. While the number of training and testing events would change under this supplement, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.4 (Entanglement Stressors) remains valid.

#### 3.8.2.5.1 Impacts from Entanglement Stressors Under Alternative 1

Under Alternative 1, the number of fiber optic cables (Table 3.0-22), guidance wires (Table 3.0-22), and decelerators/parachutes (Table 3.0-24) that would be expended during training and testing activities would decrease compared to the number of activities proposed in the 2015 MITT Final EIS/OEIS. Decreases in the number of training and testing events would potentially decrease the level of entanglement stressors in the Study Area.

As stated in the 2015 MITT Final EIS/OEIS, the impact of fiber optic cables, guidance wires, and decelerators/parachutes on marine invertebrates, including those that live in hydrothermal vents, is not likely to cause injury or mortality to individuals, and impacts would be negligible because (1) the area exposed to the stressor is extremely small (localized) relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one activity, and (3) marine invertebrates are not particularly susceptible to entanglement stressors. Activities involving cables, guidance wires, and decelerators/parachutes are not expected to yield any behavioral changes or lasting impacts on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Therefore, impacts on marine invertebrates from entanglement stressors such as wires and cables and decelerators/parachutes under Alternative 1 would be negligible.

*Pursuant to the ESA, the use of fiber optic cables and guidance wires, and* decelerators/parachutes *during training and testing activities, as described under Alternative 1, may affect ESA-listed coral species.*

#### 3.8.2.5.2 Impacts from Entanglement Stressors Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the number of fiber optic cables (Table 3.0-22) decrease, guidance wires (Table 3.0-22) increase, and decelerators/parachutes (Table 3.0-24) decrease compared to the number of activities proposed in the 2015 MITT Final EIS/OEIS and would increase or stay the same compared to Alternative 1. However, as stated above for Alternative 1, training and testing activities involving fiber optic cables, guidance wires, and decelerators/parachutes are not expected to yield any behavioral changes or lasting impacts on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels for the same reasons detailed above for Alternative 1.

Therefore, impacts on marine invertebrates from entanglement stressors such as wires and cables and decelerators/parachutes under Alternative 2 would be negligible.

*Pursuant to the ESA, the use of fiber optic cables and guidance wires, and* decelerators/parachutes *during training and testing activities, as described under Alternative 2, may affect ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.5.3 Impacts from Entanglement Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Entanglement stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer entanglement stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for entanglement impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.6 Ingestion Stressors

Types of materials that could become ingestion stressors during training and testing activities in the Study Area include non-explosive practice munitions (small- and medium-caliber), fragments from explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), and decelerators/parachutes. While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.5 (Ingestion Stressors) remains valid.

Expended materials could be ingested by marine invertebrates at the surface, in the water column, or on the seafloor, depending on the size and buoyancy of the expended object and the feeding behavior of the animal. Floating material is more likely to be eaten by animals that feed at or near the water surface, while materials that sink to the seafloor present a higher risk to both filter-feeding sessile (i.e., corals) and bottom-feeding animals (seastars and sea cucumbers). Marine invertebrates are universally present in the water and the seafloor, with many individuals being smaller than a few millimeters (e.g., zooplankton, most roundworms, and most arthropods). Most military expended materials and fragments of military expended materials are too large to be ingested by marine invertebrates. The potential for marine invertebrates to encounter fragments of ingestible size increases as the military expended materials degrade into smaller fragments.

#### 3.8.2.6.1 Impacts from Ingestion Stressors Under Alternative 1

Under Alternative 1, the combined number of ingestion stressors would increase compared to the number in the 2015 MITT Final EIS/OEIS (see Tables 3.0-14 through 3.0-17, Table 3.0-25, and Table 3.0-26). However, increases in the number of ingestion stressors do not appreciably change the impact analysis or conclusions presented in the 2015 MITT Final EIS/OEIS.

As stated in the 2015 MITT Final EIS/OEIS, most military expended materials and fragments of military expended materials are too large to be ingested by marine invertebrates, including those that live in hydrothermal vents. The potential for marine invertebrates to encounter fragments of ingestible size increases as the military expended materials degrade into smaller fragments. The increase in military expended materials, primarily from small-caliber projectiles, would not represent an ingestion risk for marine invertebrates. Only a small fraction of military expended materials would be of ingestible size, or become ingestible after degradation; while those may impact individual marine invertebrates, such as ESA-listed corals, they are unlikely to impact populations. Therefore, impacts on marine invertebrates from ingestion of military expended materials under Alternative 1 would be negligible.

*Pursuant to the ESA, the use of military expended materials of ingestible size during training and testing activities, as described under Alternative 1, may affect ESA-listed coral species.*

#### 3.8.2.6.2 Impacts from Ingestion Stressors Under Alternative 2 (Preferred Alternative)

Under Alternative 2, the combined number of ingestion stressors would increase compared to the number in the 2015 MITT Final EIS/OEIS and as compared to Alternative 1 (see Tables 3.0-14 through 3.0-17, Table 3.0-25, and Table 3.0-26). However, these increases do not appreciably change the impact analysis or conclusions presented in the 2015 MITT Final EIS/OEIS and those summarized above under Alternative 1.

Therefore, impacts on marine invertebrates from ingestion of military expended materials under Alternative 2 would be negligible.

*Pursuant to the ESA, the use of military expended materials of ingestible size during training and testing activities, as described under Alternative 2, may affect ESA-listed coral species. The Navy is consulting with NMFS as required by Section 7(a)(2) of the ESA.*

#### 3.8.2.6.3 Impacts from Ingestion Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Ingestion stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer ingestion stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for ingestion impacts on individual invertebrates, but would not measurably improve the status of invertebrate populations or subpopulations.

### 3.8.2.7 Secondary Stressors

Potential impacts on marine invertebrates exposed to stressors could occur indirectly through sediments and water quality. Stressors from Navy training and testing activities could pose secondary or indirect impacts on marine invertebrates via habitat, sediment, or water quality. Components of these stressors that could pose indirect impacts include (1) explosives and byproducts; (2) metals; (3) chemicals; and (4) other materials such as targets, chaff, and plastics.

While the number of training and testing events would change under this SEIS/OEIS, the analysis presented in the 2015 MITT Final EIS/OEIS, Section 3.8.3.6 (Secondary Stressors) remains valid. As stated in the 2015 MITT Final EIS/OEIS, indirect impacts of explosives and unexploded ordnance on marine invertebrates via water are likely to be negligible and not detectable for two reasons. First, most explosives and explosive degradation products have very low solubility in sea water. This means that dissolution occurs extremely slowly, and harmful concentrations of explosives and degradation are not likely to accumulate except within confined spaces. Second, a low concentration of byproducts, slowly delivered into the water column, is readily diluted to non-harmful concentrations. Filter feeders in the immediate vicinity of degrading explosives may be more susceptible to bioaccumulation of chemical byproducts. While marine invertebrates may be adversely impacted by the indirect effects of degrading explosives via water (Rosen & Lotufo, 2007; 2010), this is extremely unlikely in realistic scenarios.

Impacts on marine invertebrates, including zooplankton, eggs, and larvae, are likely within a very small radius of the ordnance (1–6 ft. [0.3–1.8 m]). These impacts may continue as the ordnance degrades over months to decades. Because most ordnance is deployed as projectiles, multiple unexploded or low-order detonations would accumulate on spatial scales of 1 to 6 ft. (0.3 to 1.8 m.); therefore, potential impacts are likely to remain local and widely separated. Given these conditions, the possibility of population-level impacts on marine invertebrates is negligible. However, if the sites of the depositions are the same over time, this could alter the benthic composition, affect bioaccumulation, and impact local invertebrate communities.

Erosion as a result of training activities at FDM may contribute to deposition of soils into the nearshore areas of FDM, causing increased turbidity. However, cliff face vertical targets used as part of Naval surface fire support training have been moved to reduce erosion and potential impacts on the cliff face, as well as biological resources. Turbidity can impact corals and invertebrate communities on hard-bottom areas by reducing the amount of light that reaches these organisms and by clogging siphons for filter-feeding organisms. Reef-building corals are sensitive to water clarity because they host symbiotic algae that require sunlight to live. Encrusting organisms residing on hard bottom can be impacted by persistent silting from increased turbidity. However, the impacts of explosive byproducts on sediment and water quality would be indirect, short term, local, and negative. Explosive ordnance could loosen soil on FDM, and runoff from surface drainage areas containing soil and explosive byproducts could subsequently enter nearshore waters. Impacts on marine invertebrates from erosion or sedimentation could occur.

As stated in the 2015 MITT Final EIS/OEIS, concentrations of metals in water are extremely unlikely to be high enough to cause injury or mortality to marine invertebrates; therefore, indirect impacts of metals via water are likely to be negligible and not detectable. Given these conditions, the possibility of population-level impacts on marine invertebrates is likely to be negligible and not detectable. In addition, concentrations of chemicals in sediment and water are not likely to cause injury or mortality to marine invertebrates; therefore, indirect impacts of chemicals via sediment and water are likely to be negligible and not detectable. Population-level impacts on marine invertebrates would be negligible and not detectable.

In addition, as stated in the 2015 MITT Final EIS/OEIS, plastics could impact marine invertebrates via sediment. Harmful chemicals in plastics interfere with metabolic and endocrine processes in many plants and animals (Derraik, 2002). Potentially harmful chemicals in plastics are not readily adsorbed to marine sediments; instead, marine invertebrates are most at risk via ingestion or bioaccumulation. Because plastics retain many of their chemical properties as they are physically degraded into microplastic particles (Singh & Sharma, 2008), the exposure risks to marine invertebrates are dispersed over time. Marine invertebrates could be indirectly impacted by chemicals from plastics but, absent bioaccumulation, these impacts would be limited to direct contact with the material because relatively few military expended materials contain plastics. Therefore, population-level impacts on marine invertebrates attributable to Navy-expended materials are likely to be negligible and not detectable.

### 3.8.3 Public Comments

The public raised a number of issues during the scoping period in regard to marine invertebrates. The issues are summarized in the list below. Comments received from the public during the Draft SEIS/OEIS commenting period related to marine invertebrates are addressed in Appendix K (Public Comment Responses).

- **Sonar disrupting larval recruitment –** As described in the 2015 MITT Final EIS/OEIS, corals throughout the Study Area may be exposed to non-impulse sounds generated by sonar and other transducers, vessels, and aircraft during training and testing activities. However, the vast majority of underwater acoustic sources would not be used in the shallow waters (less than 100 ft. [30 m.]) where the majority of coral species are known to exist. Sound from training and testing activities is intermittent or transient, or both, and would not occur close enough to reefs to interfere with larval perception of reef noise. The Navy also looked at impacts on the individual polyp or medusae from the use of sonar in relation to the overall number, or population, of coral medusae or polyps. In addition, as described above in Section 3.8.1.1 (Sound Sensing and Production), invertebrate species detect sounds through particle motion, which diminishes rapidly from the sound source. Most activities using sonar or other transducers would be conducted in deep-water, offshore areas of the Study Area and would not affect invertebrates. Furthermore, invertebrate species have their best hearing sensitivity below 1 kHz and would not be capable of detecting the majority of sonars and other transducers used in the Study Area.

- **Impacts from precision anchoring activities –** As described in Section 3.7.3.2.3 (Impacts from Seafloor Devices) of the 2015 MITT Final EIS/OEIS, precision anchoring would typically occur within predetermined shallow water anchorage locations near ports where the seafloor consists of unconsolidated sediments and lacks marine vegetation. These areas do not contain coral reefs. Additional mitigation measures for shallow water coral reefs used to avoid or reduce impacts from precision anchoring are presented in Chapter 5 (Mitigation).

- **Persistence of chemicals in ordnance when debris becomes encased in coral –** As described in Section 3.8.3.3.2.1 (Military Expended Materials that are Ordnance) of the 2015 MITT Final EIS/OEIS, the physical and chemical properties of the surrounding water from an ordnance strike would be temporarily altered (e.g., slight heating or cooling and increased oxygen concentrations due to turbulent mixing with the atmosphere), but there would be no lasting change resulting in long-term impacts on marine invertebrates. In addition, Section 3.8.3.6 (Secondary Impacts) in the 2015 MITT Final EIS/OEIS determined that the impacts on sedentary invertebrate beds and reefs from the use of metal, chemical, and other material byproducts, and secondary physical disturbances during training and testing activities would be minimal and short term within the Study Area.

- **Secondary impacts on ESA species, including coral reefs from training activities on FDM –** The 2015 MITT Final EIS/OEIS analyzed potential impacts on marine resources, including ESA-listed coral species, using the best available data. Similarly, the Navy conducted an extensive review of recent literature, including government technical documents and reports, and online scientific journal databases to add any new information to this document. This information supports the conclusions from the 2015 MITT Final EIS/OEIS that secondary impacts on coral reefs from explosives and explosive byproducts could occur, while impacts on marine invertebrates from erosion or sedimentation are not anticipated. In addition, indirect impacts from metals and other chemicals in the marine environment are likely to be negligible and not detectable.

- **Direct impacts on coral reefs, coral spawning periods, and other invertebrates from sedimentation/erosion around FDM –** As detailed in Section 3.1 (Sediments and Water Quality), recent multi-year dive studies were conducted by Smith and Marx (2016) at FDM. These surveys found that coral fauna at FDM are healthy and robust and the nearshore physical environment and basic habitat types at FDM remained unchanged over the 13 years (1999–2012). These conclusions are based on (1) a limited amount of physical damage, (2) very low levels of partial mortality and disease (less than 1 percent of all species observed), (3) absence of excessive mucus production, (4) good coral recruitment, (5) complete recovery by 2012 of the 2007 bleaching event, and (6) a limited number of macrobioeroders and an absence of invasive crown of thorns starfish (*Acanthaster planci*). These factors suggest that sedimentation that may result from military use of FDM is not sufficient as to adversely impact water quality and coral communities. A recent coral reef survey by Carilli et al. (2018) at FDM verified Endangered Species Act (ESA)-listed corals, quantified coral reef health, and compiled observations of ordnance impacts. The survey results indicated that ESA-listed corals are present, but rare in waters of <20 meters depth around FDM. Additionally, 77.3 percent of corals observed exhibited some form of bleaching, likely caused by regionally anomalous warm sea surface temperatures. Carilli et al. (2018) also found little evidence of adverse impacts on coral from Navy training at FDM, including from the use of high-explosive bombs. In addition, they found that scleractinian coral growth occurred on a substantial percentage of ordnance items expended.

- **Direct and cumulative impacts from military expended materials as marine debris –** The 2015 MITT Final EIS/OEIS and this SEIS/OEIS analyzed potential direct and cumulative impacts of military expended materials on marine invertebrates through physical disturbance and strike, entanglement, and ingestion. The majority of these materials are expended in open ocean areas where impacts on biological communities, such as coral reefs, would be minimized.

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